(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 391 559 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification : **14.09.94 Bulletin 94/37**

(51) Int. Cl.[5] : **G07F 7/08**, G07F 1/06, G06K 7/00

(21) Application number : **90302860.3**

(22) Date of filing : **16.03.90**

(54) **Transaction system.**

(30) Priority : **01.04.89 GB 8907398**

(43) Date of publication of application : **10.10.90 Bulletin 90/41**

(45) Publication of the grant of the patent : **14.09.94 Bulletin 94/37**

(84) Designated Contracting States : **DE FR**

(56) References cited :
EP-A- 0 147 099
FR-A- 2 600 448
GB-A- 2 208 025

(73) Proprietor : **GEC AVERY LIMITED**
Smethwick
Warley, West Midlands, B66 2LP (GB)

(72) Inventor : **Morley, Julian David**
10, Alswitha Terrace
Hyde, Winchester SO23 7DQ (GB)

(74) Representative : **Elliott, Frank Edward et al**
GEC Patent Department
(Chelmsford Office)
GEC-Marconi Research Centre
West Hanningfield Road
Great Baddow Chelmsford Essex CM2 8HN
(GB)

EP 0 391 559 B1

Description

This invention relates to a transaction system, and in particular it relates to a system including a terminal for reading from and writing to an electronic token which has an onboard data processing capability. Such a token is often in the form of an elongate card and may be termed a "Smart Card". The terminal may be a stand alone unit with which data held within the token can be read or altered or alternatively the terminal may be connected by a remote or local link to an external host such as a bank's computer.

Systems of this type have become well established in recent years and generally take the form of a terminal fixed at a certain place, such as a bank, and a token which is portable and is issued to an individual who carries the token around and brings it to the terminal when a transaction is deemed necessary. The system may be of the contact type in which the token must physically touch the terminal in order for communication to be established or may be of the contactless type which utilises for example, inductive coupling. This invention is related to the latter-mentioned type of coupling.

It is evident that in this type of system a terminal is in communication with a token only for short periods of time but it is important that, when a token is brought towards the terminal, the terminal recognises this and is able relatively quickly to establish communication. It is preferable that the user does not have to 'switch on' the terminal each time he wants to use it. Thus, in inductively coupled systems which use a carrier wave transmitted from the terminal to the token the terminal may be permanently energised so that when the token is brought towards the terminal it is immediately powered up. In an alternative form as described in GB 2208025 A the terminal is arranged to transmit the carrier signal at a relatively low stand-by level and, after detecting a token, to raise the level of the carrier to a higher level equal to the operating level. Since the carrier signal is permanently on, albeit at a low level, the terminal still consumes a considerable amount of power when in its 'dormant' mode.

The present invention arose from a need to reduce still further this power requirement.

According to the present invention there is provided a transaction system comprising a first body arranged to communicate inductively with a second body, the first body comprising means for generating and transmitting a radio frequency signal and means for monitoring the level of the transmitted signal to detect the presence of the second body, characterised in that the signal is transmitted as pulses and in that the monitoring means is arranged to detect whether the level of the pulse is below a threshold level within a chosen period of time equal to or less than the pulse duration, indicating that the second body is in inductive proximity, and to initiate communication between the first and second bodies.

Thus, a system embodying the invention causes a first body (the terminal) to pulse its carrier r.f. signal, and, if a second body (a token) is brought into the proximity of the terminal then the r.f. level in that particular pulse will not exceed the threshold value since the token will draw power and thus reduce the level of the r.f. field. Once the token is sensed then the r.f. generating means may be left on permanently and a transaction allowed to be conducted. When the token is subsequently removed, the output voltage level will rise again (because less current is being drawn) and hence will exceed the threshold, thus cutting off the permanent r.f. signal and reverting to pulsed mode.

In an alternative system, once a token is detected, the pulse of r.f. is allowed to complete and the pulse cycle allowed to continue, but means are provided in the system for noting that the token is present and awaiting a signal from an external device, such as a host computer for example, to switch the r.f. generating means on permanently. This may be useful in some particular applications.

Preferably a pulse is transmitted once every second or once every 100 mS depending upon whether, respectively, low power consumption or quick response is required. The pulse width is typically of 150 micro seconds.

In a preferred embodiment, analogue circuitry in the terminal, which circuitry typically includes signal processing circuitry for processing data from the token to the terminal, is first powered up, typically for a period of 10 mS. In the last 0.15 mS of this 10 mS time period the r.f. pulse is generated. This is because the analogue circuitry requires a short time to settle down but must be settled to detect an 'answer to reset' character from a token, which is produced a short period after the token is powered up by the r.f. pulse from the terminal.

Embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows schematically the elements of a read/write terminal.

Figure 2 shows schematically elements of a terminal in accordance with the present invention; and

Figures 3 and 4 are waveform diagrams.

Referring to Figure 1 there is shown in block form elements of a terminal constituting a first body of a transaction system which is suitable for interaction, by means of inductive coupling between first and second bodies, with an electronic token constituting a second body. The token (6) comprises processing means and memory means. The terminal is of the type which transmits data by means of modulation of an r.f. carrier signal. In a typical example, data to be transmitted from the terminal to the token is transmitted by frequency modulation of the carrier wave and data from the token to the terminal is transmitted by

a level or amplitude modulation of that same wave. The terminal comprises an r.f. source 1, for example, of 300 kHz which may be switched on and off or pulsed by apparatus which is further described below with reference to Figure 2. This carrier signal is fed to modulation and/or demodulation circuitry 2 where either an FM modulation corresponding to data to be transmitted is applied to the carrier or amplitude modulation from data received is detected. The data is passed to or from analogue and/or digital processing circuitry 3. The modulated signal is passed to a tuned circuit 4 which includes an inductive loop 5. This generates a varying magnetic field which is detected by a similar loop on a token 6. A voltage monitoring circuit 7 monitors the voltage across the loop due to the signal at the tuned circuit 4 and is used to detect whether a token is present or not as a token, by drawing power, will lower the level of the voltage of the r.f. signal. A switch 8 is shown schematically as a control switch for the r.f source.

Referring now to Figure 2 there is shown a system in which the output of the terminal is controlled. The system comprises an oscillator, such as a 12 MHz crystal oscillator 18, which is fed through a suitable divider 9 to produce a pulse once every 100 mS which is fed through a switch 9a to one input of an OR gate 10. The output from divider 9 is also fed to a Divide by Ten unit 11 to produce a pulse at a frequency of one second which is fed to a second input of OR gate 10. An output from the OR gate is fed into a monostable 12 designed to switch states after a period of 9.850 mS. An output from the OR gate 10 is also used to initiate a latch 13 which is used to control the analogue circuitry (not explicitly shown) in the terminal and is accordingly termed an analogue latch. The analogue circuitry is thus turned on once every 100 mS or 1 second depending upon whether the 100 mS signal is switched into the OR gate by switch 9a.

After a period of 9.85 mS, monostable 12 is arranged to switch state and to feed a clock signal to an r.f. latch 14 which serves to actuate the r.f. source 1 of Figure 1.

Simultaneously, a sequence controller 15 is triggered by a signal from monostable 12. The sequence controller is designed, in this embodiment, to give three outputs at different time periods after triggering. After a period of 0.075 mS a signal is fed into the clock input of a sample latch 16 which serves to actuate a token detection circuit 17; this is equivalent to the voltage monitor 7 of Figure 1 and essentially detects whether a token is present by monitoring the voltage on the r.f. line using standard techniques. After a further period of 0.05 mS, i.e. 0.125 mS from triggering, the sample latch is reset and sampling is ceased. 0.025 mS later (0.15 mS after triggering), the r.f. and analogue latches 14 and 13 are reset thus switching off the r.f. and analogue signals. Hence, the analogue circuit has been 'turned on' for 10 mS and the r.f. has been 'turned on' for 0.15 mS. A threshold value is set, above which the r.f. level will rise when a token is not present, but which is of such value that the presence of a token within a chosen range causes the r.f. level not to exceed the threshold value. The value is easily determinable, depending upon the application, component values, power requirements, etc.

The above assumes that a token is not detected during the 0.050 mS sample period. If a token is detected then the system may operate in two alternative modes. In a first mode, when a token is detected by the pulse not exceeding a threshold value within a fixed time limit (usually smaller than the pulse duration) then the r.f. source is not switched off. Instead the r.f. is left permanently on so that contact with the token can be established and a transaction, such as a financial transaction, conducted. The analogue circuitry is also left on during this period. The manner of conducting a transaction does not form part of this invention and is omitted herein.

Once the token is removed then the token detection circuit 17 which has been left permanently on, in addition to the r.f. and analogue circuits, senses that the level of the r.f. increases above the threshold value and thus turns the r.f. and analogue signals off. The system then reverts to its pulsing mode and pulses the analogue and r.f. circuits every 100 mS or 1 second as selected. A delay may be imparted into the system such that once it has been detected that the token has been removed the r.f. and analogue circuits are turned off after a fixed delay period. This process is shown more clearly in Figure 3 where A represents the internal clock frequency of 12.218 MHz. Waveform B is for a system where the pulse is initiated once every second. Waveform C shows how the analogue circuitry is switched on for a period of 10 mS when a pulse is output from OR gate 10. Waveform D shows how the r.f. source is switched on for the last 150 microseconds of this period. Some 0.075 mS later the token sample or detection circuit 17 is switched on as shown at E, for a period of 0.05 mS. If a token is introduced at any time then the token detect line will detect it and thus, as shown in the second portion of Figure 3, will leave the analogue r.f. and token detect lines open. Removal of the token is detected by the token detection circuit which, after a delay of 50 mS in this example, switches off the analogue r.f and token sample circuitry. Pulsing, as shown in the first portion of Fig. 3, is then re-established.

It should be noted that the waveforms in Figure 3 and Figure 4 are not to scale.

Figure 4 shows an alternative mode in which the first part, when a token is not present, is identical to that in the first mode. However, as shown in the second part of Figure 4, once a token is brought into the proximity of the terminal then the token detection circuit notes this but, instead of leaving the r.f. perma-

nently on, it allows it to be switched off at the end of its pulse period of 150 microseconds. The analogue circuitry is however left on permanently and also a flag is set in the system so that an external device, such as a host computer, can give a message to turn the r.f. on. The system is thus seen as being 'primed' for operation once a token is detected but operation is not actually initiated until an external device instigates it. This system may have advantages in certain applications. Upon removal of the token from proximity of the terminal the token detect line detects this removal, and, after a 50 mS delay resets the analogue control to off and enables pulsing to begin again.

Although the inductively-coupled bodies have been termed terminal and token in this specification, the invention is not limited in this regard and is suitable for use between any two bodies which communicate by means of inductive or inductive and other contactless coupling.

Claims

1. A transaction system comprising a first body arranged to communicate inductively with a second body (6), the first body comprising means for generating (1) and transmitting (4) a radio frequency signal and means (7) for monitoring the level of the transmitted signal to detect the presence of the second body, characterised in that the signal is transmitted as pulses and in that the monitoring means (7) is arranged to detect whether the level of the pulse is below a threshold level within a chosen period of time equal to or less than the pulse duration, indicating that the second body (6) is in inductive proximity, and to initiate communication between the first and second bodies.

2. A transaction system as claimed in Claim 1, characterised in that the first body is a read/write terminal and the second body (6) is a portable token having onboard data processing capability.

3. A transaction system as claimed in Claim 1 or 2, characterised in that the monitoring means (7) comprises means (7) for enabling the r.f. signal to be left permanently on until the removal of the second body (6) is detected, whereupon pulsing of the r.f. is re-established.

4. A transaction system as claimed in Claim 1 or 2, characterised in that the monitoring means comprises means for setting a flag or other indicator which is detectable by an external host to switch on the r.f. continuously.

5. A transaction system as claimed in any one of the preceding claims, characterised in that analogue circuitry within the first body is also pulsed until the second body (6) is detected, at which point it is left permanently on until the body is removed, the analogue pulses being actuated for a period of time prior to and during each r.f. pulse such that the analogue circuitry can be fully powered up before the initiation of each r.f. pulse.

6. A transaction system as claimed in any preceding claim, characterised in that the pulse repetition frequency has selectably one of two or more different values.

7. A transaction system as claimed in Claim 6, characterised in that the values are one second and 100mS.

8. A transaction system as claimed in any one of the preceding claims, characterised in that the r.f. pulse duration is 0.15 mS.

9. A transaction system as claimed in claim 5, characterised in that analogue circuitry on the first body is pulsed for periods of 10 mS and the r.f. pulse is actuated during the final 0.15 mS of the 10 mS period.

10. A read/write terminal, adapted for use as the first body as claimed in any one of the preceding claims, comprising means (1) for generating r.f. pulses, means (4) for transmitting the pulses, monitoring means (7) for monitoring the level of the transmitted r.f. pulses, and timing means (15) for enabling the monitoring means (7) to detect, within a chosen period equal to or less than the pulse duration, if the level of the transmitted pulse is below a threshold level.

Patentansprüche

1. Ein Transaktionssystem, das umfaßt: einen ersten Körper, der dazu angeordnet ist, induktiv mit einem zweiten Körper (6) zu kommunizieren, wobei der erste Körper umfaßt: ein Mittel zum Erzeugen (1) und Übertragen (4) eines Radiofrequenzsignals und ein Mittel (7) zum Überwachen des Niveaus des übertragenen Signals, um die Gegenwart des zweiten Körpers nachzuweisen, dadurch gekennzeichnet, daß das Signal als Pulse übertragen wird und dadurch, daß das Überwachungsmittel (7) dazu angeordnet ist, nachzuweisen, ob das Niveau der Pulse unter einem Schwellwertniveau innerhalb einer ausgewählten Zeitperiode gleich mit der oder kleiner als die Pulsdauer ist, was anzeigt, daß der zweite Körper (6) sich in induktiver Nähe befindet, und um die

Kommunikation zwischen den ersten und zweiten Körpern auszulösen.

2. Ein Transaktionssystem nach Anspruch 1, dadurch gekennzeichnet, daß der erste Körper ein Lese-/Schreibeterminal und der zweite Körper (6) eine tragbare Marke mit einer Borddatenverarbeitungsfähigkeit ist.

3. Ein Transaktionssystem nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Überwachungsmittel (7) ein Mittel (7) zum Befähigen des R.F.-Signals umfaßt, permanent angelassen zu werden, bis die Entfernung des zweiten Körpers (6) nachgewiesen wird, worauf das Pulsieren der R.F. wieder herbeigeführt wird.

4. Ein Transaktionssystem nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Überwachungsmittel ein Mittel zum Setzen eines Merkers oder eines anderen Indikators umfaßt, welcher durch einen externen Host nachweisbar ist, um die R.F. kontinuierlich anzuschalten.

5. Ein Transaktionssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die analoge Beschaltung innerhalb des ersten Körpers auch gepulst wird, bis der zweite Körper (6) nachgewiesen wird, bei welchem Punkt sie permanent angelassen wird, bis der Körper entfernt wird, wobei die analogen Pulse für eine Zeitspanne vor jedem R.F.-Puls und währenddessen derart betätigt werden, daß die analoge Beschaltung vollständig vor der Auslösung jedes R.F.-Pulses unter Leistung gesetzt werden kann.

6. Ein Transaktionssystem nach irgendeinem vorhergehenden Anspruch, dadurch gekennzeichnet, daß die Pulswiederholfrequenz wahlweise einen von zwei oder mehr verschiedenen Werten aufweist.

7. Ein Transaktionssystem nach Anspruch 6, dadurch gekennzeichnet, daß die Werte eine Sekunde und 100 mS sind.

8. Ein Transaktionssystem nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die R.F.-Pulsdauer 0,15 mS beträgt.

9. Ein Transaktionssystem nach Anspruch 5, dadurch gekennzeichnet, daß die analoge Beschaltung auf dem ersten Körper für Perioden von 10 mS gepulst wird und der R.F.-Puls während der letzten 0,15 mS der 10 mS-Periode betätigt wird.

10. Ein Lese-/Schreibe-Terminal, das für die Verwendung als der erste Körper wie in irgendeinem der vorhergehenden Ansprüche beansprucht ausgebildet ist, mit einem Mittel (1) zum Erzeugen von R.F.-Pulsen, einem Mittel (4) zum Übertragen der Pulse, einem Überwachungsmittel (7) zum Überwachen des Niveaus der übertragenen R.F.-Pulse und einem Zeitsteuerungsmittel (15) zum Befähigen des Überwachungsmittels (7) um innerhalb einer gewählten Periode gleich mit der oder kleiner als die Pulsdauer nachzuweisen, ob das Niveau des übertragenen Pulses unter einem Schwellniveau liegt.

Revendications

1. Système transactionnel comprenant un premier corps agencé pour communiquer de manière inductive avec un second corps (6), le premier corps comprenant un moyen pour produire (1) et pour émettre (4) un signal à haute fréquence et un moyen de surveillance (7) pour surveiller le niveau du signal émis pour détecter la présence du second corps, caractérisé en ce que le signal est émis sous forme d'impulsions et en ce que le moyen de surveillance (7) est agencé pour détecter si le niveau de l'impulsion est inférieur à un niveau de seuil, à l'intérieur d'une période de temps choisie égale ou inférieure à la durée d'impulsion, en indiquant ainsi que le second corps (6) est assez près pour permettre l'induction et pour lancer la communication entre les premier et second corps.

2. Système transactionnel selon la revendication 1, caractérisé en ce que le premier corps est un terminal de lecture/écriture et le second corps (6) est un jeton portable ayant une possibilité propre de traitement de données.

3. Système transactionnel selon la revendication 1, ou 2, caractérisé en ce que le moyen de surveillance (7) comprend un moyen (7) pour permettre que le signal à haute fréquence soit laissé en fonction en permanence jusqu'à ce que le retrait du second corps (6) soit détecté, après quoi le fonctionnement impulsionnel de la haute fréquence est rétabli.

4. Système transactionnel selon la revendication 1, ou 2, caractérisé en ce que le moyen de surveillance comprend un moyen pour activer une marque, ou un autre indicateur, qui peut être détectée par un ordinateur central externe pour mettre en fonction la haute fréquence de façon continue.

5. Système transactionnel selon l'une quelconque des revendications précédentes, caractérisé en

ce que des circuits analogiques à l'intérieur du premier corps sont également pulsés jusqu'à ce que le second corps (6) soit détecté, auquel moment ils sont laissés en fonction de façon permanente jusqu'à ce que le corps soit retiré, les impulsions analogiques étant activées pendant une période de temps avant et pendant chaque impulsion de haute fréquence de sorte que les circuits analogiques peuvent être totalement mis sous tension avant le commencement de chaque impulsion de haute fréquence.

6. Système transactionnel selon l'une quelconque des revendications précédentes, caractérisé en ce que la fréquence de répétition d'impulsion a, de manière sélective, l'une de deux, ou plus, valeurs différentes.

7. Système transactionnel selon la revendication 6, caractérisé en ce que les valeurs sont une seconde et 100 ms.

8. Système transactionnel selon l'une quelconque des revendications précédentes, caractérisé en ce que la durée d'impulsion à haute fréquence est de 0,15 ms.

9. Système transactionnel selon la revendication 5, caractérisé en ce que les circuits analogiques dans le premier corps sont pulsés pendant des périodes de 10 ms et en ce que l'impulsion à haute fréquence est activée pendant les 0,15 ms finales de la période de 10 ms.

10. Terminal de lecture/écriture, conçu pour utilisation en tant que le premier corps, tel qu'il est revendiqué dans l'une quelconque des revendications précédentes, comprenant un moyen (1) pour produire des impulsions à haute fréquence, un moyen (4) pour émettre les impulsions, un moyen de surveillance (7) pour surveiller le niveau des impulsions à haute fréquence émises, et un moyen de cadencement (15) pour permettre au moyen de surveillance (7) de détecter, à l'intérieur d'une période choisie, égale ou inférieure à la durée d'impulsion, si le niveau de l'impulsion émise est inférieur à un niveau de seuil.

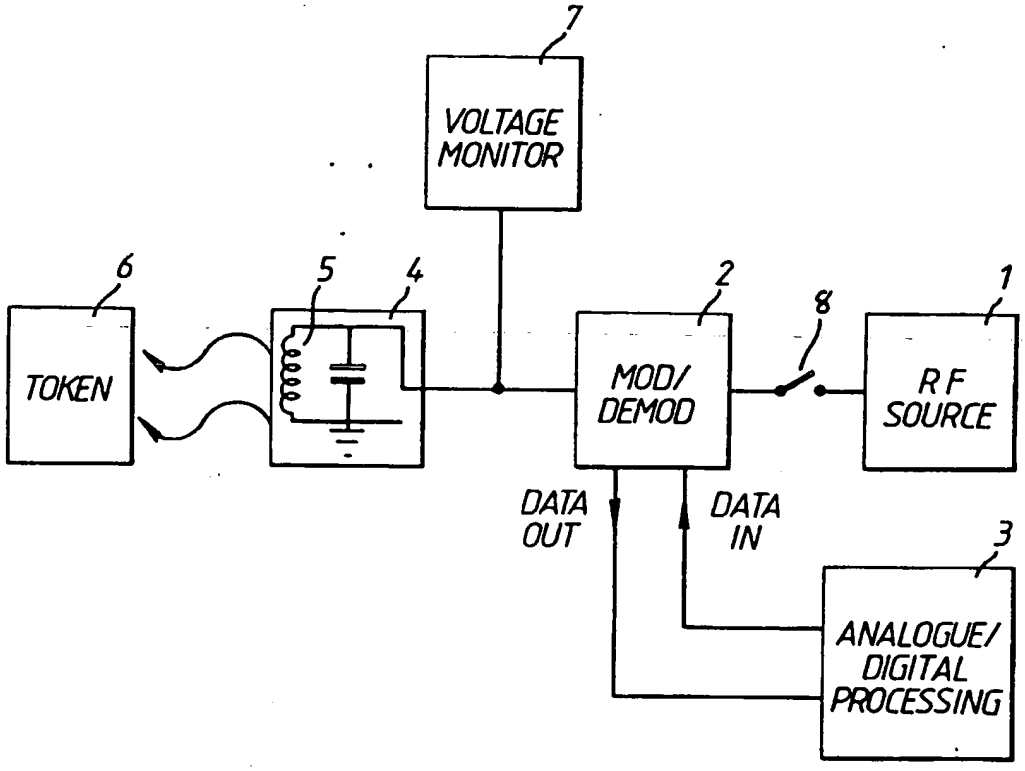
7
VOLTAGE MONITOR
6
TOKEN
5
4
2
MOD/ DEMOD
8
1
RF SOURCE
DATA OUT
DATA IN
3
ANALOGUE/ DIGITAL PROCESSING

Fig.1.

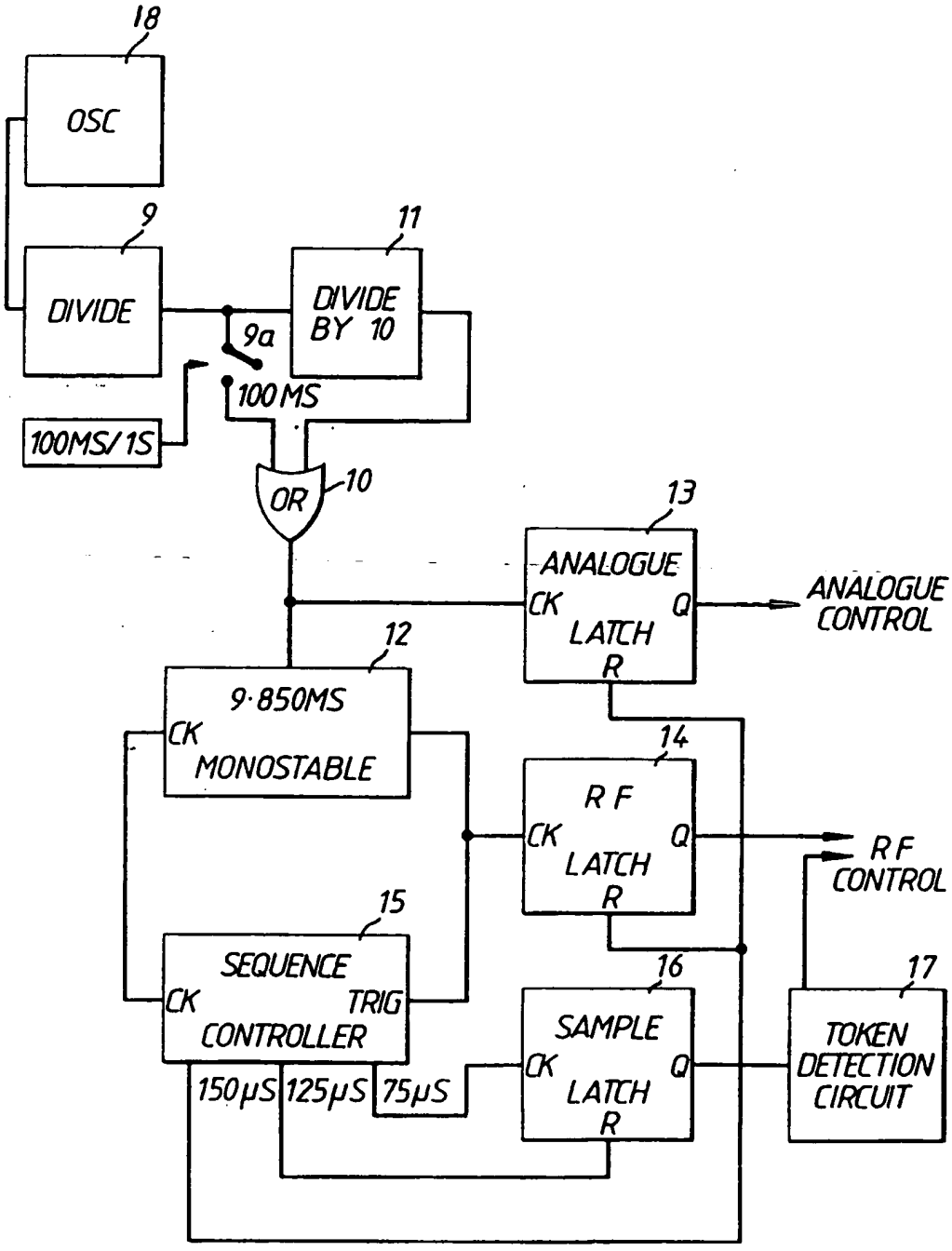
18
OSC
9
DIVIDE
11
DIVIDE BY 10
9a
100MS
100MS/1S
OR
10
13
ANALOGUE
CK
LATCH
R
Q
ANALOGUE CONTROL
12
9·850MS
CK
MONOSTABLE
14
R F
CK
LATCH
R
Q
RF CONTROL
15
SEQUENCE
CK
TRIG
CONTROLLER
16
SAMPLE
CK
LATCH
R
Q
17
TOKEN DETECTION CIRCUIT
150µS
125µS
75µS

Fig.2.

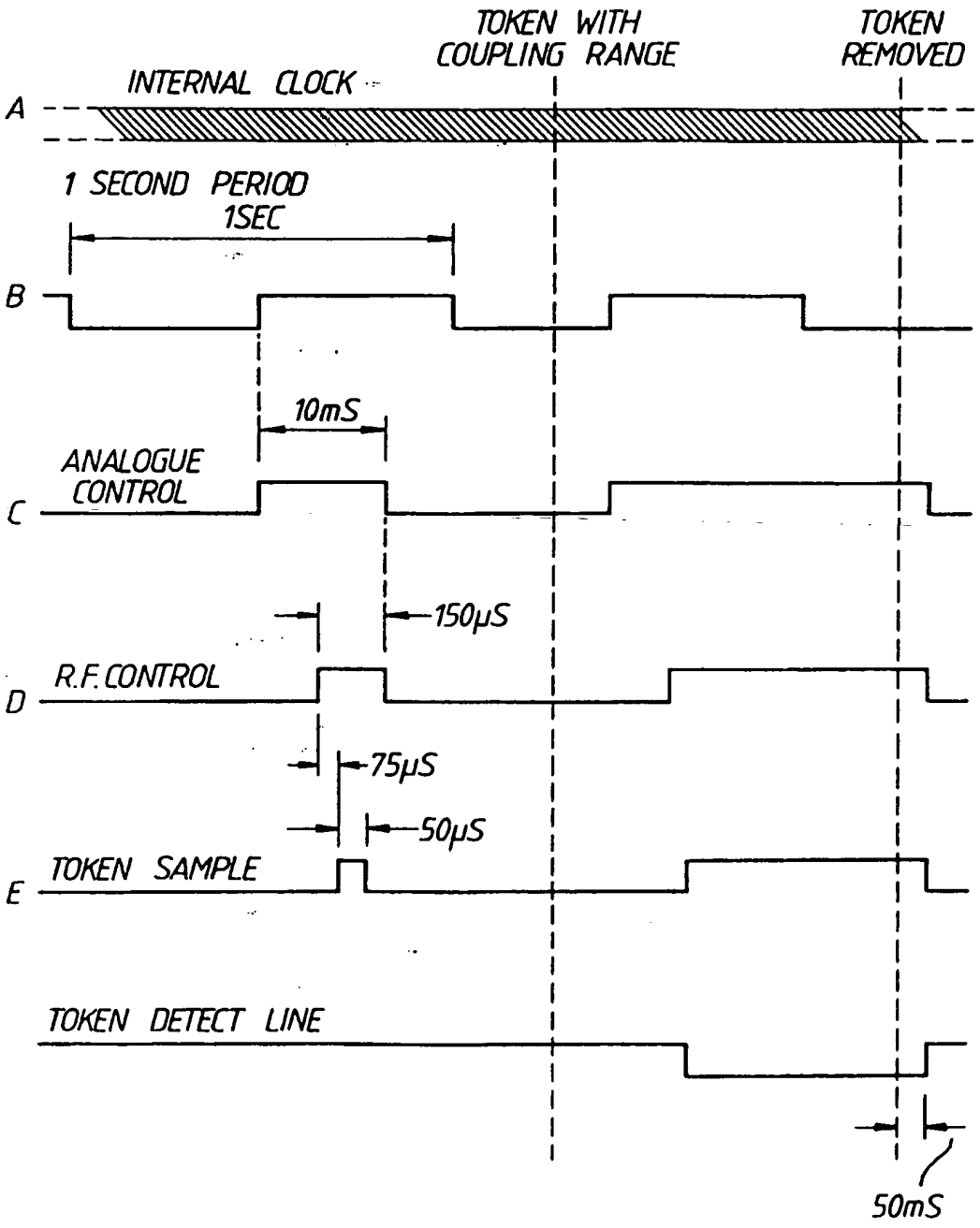
TOKEN WITH COUPLING RANGE
TOKEN REMOVED
INTERNAL CLOCK
A
1 SECOND PERIOD
1SEC
B
10mS
ANALOGUE CONTROL
C
150µS
R.F. CONTROL
D
75µS
50µS
TOKEN SAMPLE
E
TOKEN DETECT LINE
50mS

Fig.3.

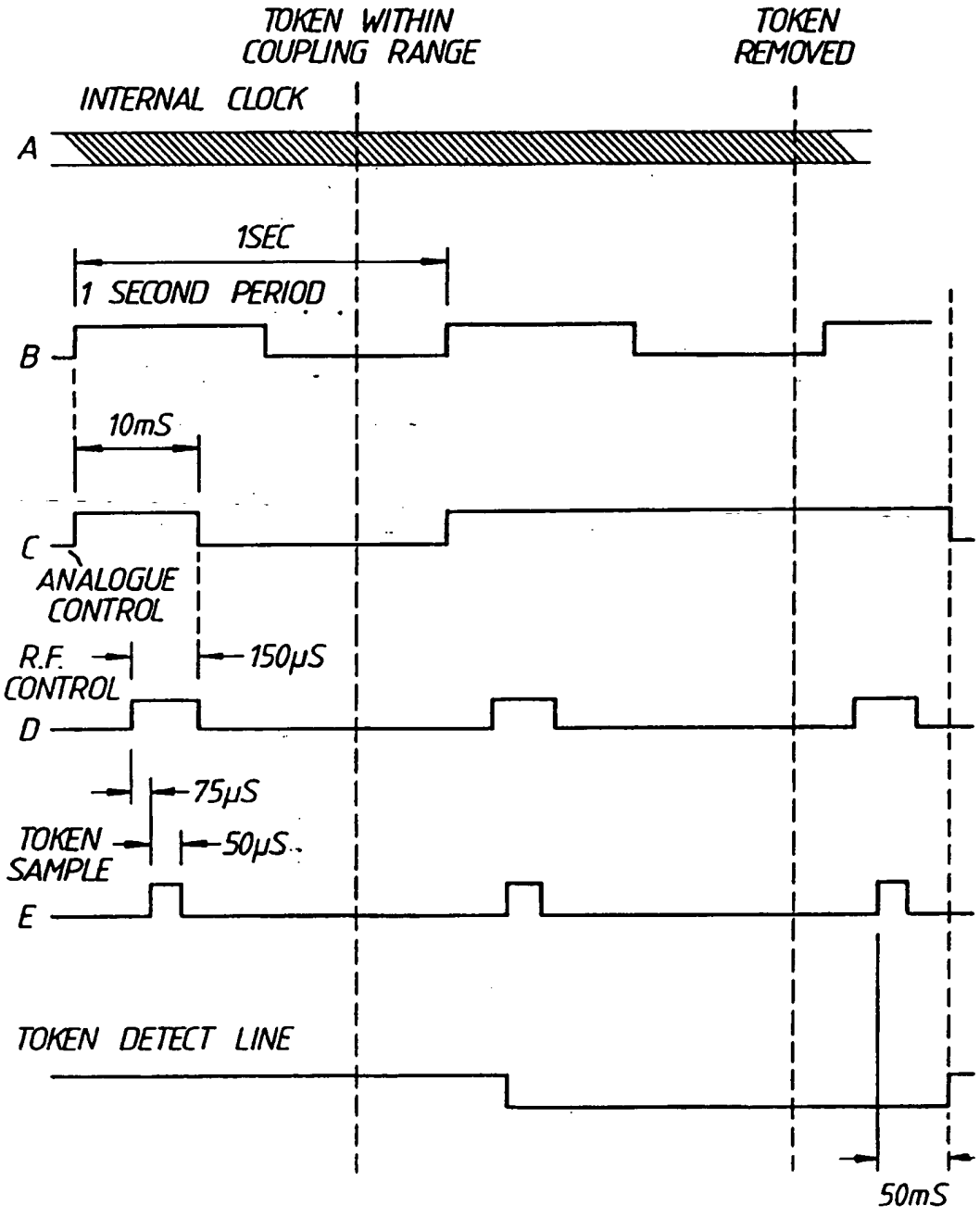
TOKEN WITHIN COUPLING RANGE
TOKEN REMOVED
INTERNAL CLOCK
A
1SEC
1 SECOND PERIOD
B
10mS
C
ANALOGUE CONTROL
R.F. CONTROL
150µS
D
75µS
TOKEN SAMPLE
50µS
E
TOKEN DETECT LINE
50mS

Fig.4.